

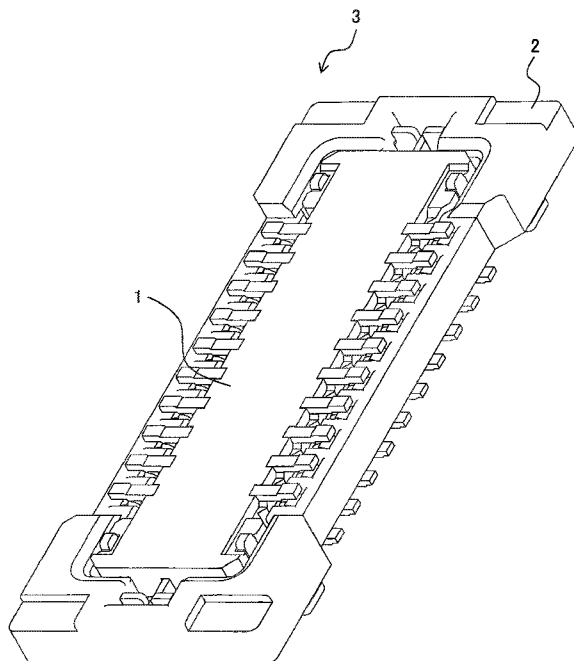


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[Continued on next page]

(54) Title: CONNECTOR

Fig. 1



(57) Abstract: There is provided an electrical connector including a first connector having a first engaging member with a protrusion; a second connector having a second engaging member formed with a cutout; wherein the protrusion is engaged with the cutout so that the first connector and the second connector are electrically connected to each other; and the cutout is configured to suppress the protrusion from rotating in the cutout. The electrical connector has a structure to avoid the inclined unmating associating with a high risk that the fitted connectors might be unintentionally released from the fitted state.



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CONNECTOR

REFERENCE TO RELATED APPLICATIONS

[0001] The Present Application claims priority to prior-filed Japanese Patent Application No. 2009-206691, entitled "Connector," and filed 08 September 2009, the contents of which is fully incorporated in its entirety herein.

BACKGROUND OF THE PRESENT APPLICATION

[0002] The Present Application relates to a connector. In particular, the Present Application relates to an electrical connector which electrically connects a board to a board.

[0003] An electrical connector such as a board-to-board connector has been hitherto known, which electrically connects a pair of boards arranged in parallel to each other. The board-to-board connector is provided with a pair of connectors which are attached to mutually opposing surfaces of the pair of boards respectively. The connectors are electrically connected to the boards respectively. One of the boards and the other of the boards are electrically connected to each other by the electric connection brought about between the connectors. The electrical connection between the boards and the connectors and the electrical connection between the connectors are performed by a plurality of contacts or contact terminals (connector terminals) which are provided on the respective connectors. The board and the connector are electrically connected to each other by soldering the contact terminals to the board. The connectors are electrically connected to each other by the elastic contact brought about between the contact terminals soldered to the respective boards.

[0004] In general, the electrical connector is a part capable of being mated and unmated (capable of detachably mating to each other). The force required to release the connectors from being mated or fitted, *i.e.*, the unmating force is appropriately set. As disclosed in Japanese Patent Application No. 2000-260509, the fitting between the connectors is retained by the elastic contact between the contact terminals as described above. Therefore, the unmating force of the electrical connector is determined, for example, by the number of contact terminals (number of terminals) and the contact force brought about between the contact terminals.

[0005] The unmating force of the electrical connector is maximized or greatest in an operation (hereinafter referred to as "parallel unmating") for separating the boards, to which the respective

connectors are connected, from each other while maintaining the boards in parallel to release the connectors from the fitting (from the fitted state). In this situation, it is most difficult to release the connectors from the fitting. On the other hand, the unmating force of the electrical connector is minimized or smallest in an operation (hereinafter referred to as “inclined or oblique unmating”) wherein the boards are separated from each other while inclining one board with respect to the other board to release the connectors from the fitting or fitted state. In the inclined unmating, the boards are unmated such that one board is separated from the other board to exfoliate or peel off one board from an end portion thereof, and that the connector which is attached to one board is separated from the connector which is attached to the other board, while rotating the connector which is attached to one board. In this case, the connectors are released from the fitting most easily.

[0006] The inclined unmating will be explained with reference to Fig. 12. An electrical connector 1000 includes a plug connector 800 and a receptacle connector 900. The plug connector 800 is attached to a board 801, and the receptacle connector 900 is attached to a board 901. The board 801 and the board 901 are electrically connected to each other by the fitting brought about between the connectors. A large number of plug contacts 851a, 851b and a large number of receptacle contacts 951a, 951b, which are aligned in two arrays or rows respectively, are attached or installed to the plug connector 800 and the receptacle connector 900 respectively. Upon fitting the plug connector 800 and the receptacle connector 900 to each other, the plug contacts 851a, 851b and the receptacle contacts 951a, 951b are engaged with each other respectively to form arrays of contact terminals (contact terminal arrays) constructed of a plurality of engaging pairs. Owing to the engagement of the contact terminals, the fitting is retained between the plug connector 800 and the receptacle connector 900.

[0007] In a case that the electrical connector 1000 is subjected to the parallel unmating by moving the electrical connector 1000 upwardly and downwardly, if the two arrays are simultaneously released from the engagement of the contact terminal arrays, then the unmating force is increased since the plurality of contact terminal arrays are simultaneously released from the engagement. On the other hand, in a case that the electrical connector 1000 is subjected to the inclined unmating, as shown in Fig. 12, one of the contact terminal arrays is released from the engagement, and the other of the contact terminal arrays is subsequently released from the engagement. Therefore, the fitting between the connectors can be released by the force required

to release one array of the contact terminals from the engagement. Further, in the inclined unmating, the board 801 is separated from the board 901 while rotating the board 801 about a contact point 802, at which the board 801 contacts with the electrical connector 1000, as the center of rotation. Therefore, the connectors can be released from the fitting by the smaller force owing to the principle of leverage.

[0008] As described above, the unmating force of the inclined unmating is smaller than that of the parallel unmating in the electrical connector. Therefore, a problem arises such that the connectors are unexpectedly released from the fitting when any force in the inclined direction is applied to the connector or the board to which the connector is attached.

[0009] In recent years, a flexible printed circuit board or boards (FPC) is/are more frequently used for one or both of a pair of boards connected by the electrical connector. FPC is thin and highly flexible. For example, it is assumed that a finger of an operator or a part (component) might be erroneously brought in contact with FPC to which the connector is attached, FPC might be bent or curved, and any force in the inclined direction might be applied to the connector. In this situation, since the unmating force in the inclined direction is small, there is such a possibility that the connectors might be unexpectedly released from the fitting. As FPC is used more frequently, the risk is increased in relation to the inclined unmating of the electrical connector as described above.

[0010] On the other hand, it has been suggested that the unmating force is increased or enhanced by providing a strong lock mechanism for an electrical connector. With a strong lock mechanism, it is possible to strengthen or reinforce both of the unmating forces of the parallel unmating and the inclined unmating. However, a lock releasing method for such strong lock mechanism is complicated in many cases. Since the electrical connector is a part capable of being mated and unmated, it is desirable that an operation for releasing the connectors from being fitted is easy.

SUMMARY OF THE PRESENT APPLICATION

[0011] The Present Application has been made taking the foregoing circumstances into consideration, an object of which is to avoid fitted connectors from unintentionally or inadvertently released from the fitted state. Specifically, an object of the Present Application is to provide an electrical connector having a structure capable of avoiding the inclined unmating

which involves a high risk that the fitted connectors are unintentionally released from the fitted state.

[0012] According to an aspect of the Present Application, there is provided an electrical connector 3 including; a first connector 1 having a first engaging member 51 with a protrusion 54; a second connector 2 having a second engaging member 151 formed with a cutout 154; wherein the protrusion 54 is engaged with the cutout 154 so that the first connector 1 and the second connector 2 are electrically connected to each other; and the cutout 154 is configured to suppress the protrusion 54 from rotating in the cutout 154.

[0013] In the electrical connector of the Present Application, the protrusion of the engaging member attached or installed to the connector is suppressed from rotating when the force in the inclined direction is applied to the connector or the board. Therefore, the rotation of the connector is also suppressed, and the inclined unmating is avoided. On the other hand, in the electrical connector of the Present Application, the connectors can be released from the fitting by the parallel unmating which does not involve any rotation of the connector. In the electrical connector of the Present Application, the protrusion is moved along the cutout, to thereby release the protrusion and the cutout from the engagement. Therefore, the boards which are electrically connected to each other can be separated from each other while retaining the boards in parallel; and the electrical connector can be subjected to the parallel unmating. Therefore, the electrical connector of the Present Application makes it possible to avoid any unintentional release of the fitting between the connectors.

BRIEF DESCRIPTION OF THE FIGURES

[0014] The organization and manner of the structure and operation of the Present Application, together with further objects and advantages thereof, may best be understood by reference to the following Detailed Description, taken in connection with the accompanying Figures, wherein like reference numerals identify like elements, and in which:

[0015] Fig. 1 is a perspective view of a board-to-board connector 3 in a state that a plug connector 1 and a receptacle connector 2 are fitted to each other, according to the Present Application, as seen from the side of the plug connector 1;

[0016] Fig. 2 is a perspective view of the plug connector 1 of Fig. 1, as seen from the side of a fitting surface on which the plug connector is fitted to the receptacle connector 2;

[0017] Fig. 3 is a perspective view of a plug engaging member 51 of the Present Application;

[0018] Fig. 4 is a perspective view of the receptacle connector 2 of Fig. 2, as seen from the side of a fitting surface on which the plug connector is fitted to the plug connector 1;

[0019] Fig. 5 is a perspective view of the receptacle connector 2 of Fig. 2, as seen from a side (mounting side) on which the receptacle connector 2 is to be mounted on a board 191;

[0020] Fig. 6 is a perspective view of a receptacle engaging member 151 of the Present Application;

[0021] Fig. 7 is a perspective view of the plug engaging members 51 of Fig. 3 and the receptacle engaging members 151 of Fig. 6;

[0022] Fig. 8 is a perspective view of the receptacle engaging members 151 of Fig. 6 and the plug engaging members 51 of Fig. 3 which are attached to the plug connector 1;

[0023] Fig. 9 is a perspective view showing a where that the receptacle engaging members 151 are engaged with the plug engaging members 51 attached to the plug connector 1;

[0024] Figs. 10A and 10B show a state that the plug engaging member 51 and the receptacle engaging member 151 are engaged with each other, wherein Fig. 10A is a top view as seen from the side of the plug engaging member 51 and Fig. 10B is a front view as seen from the side of the receptacle engaging member 151;

[0025] Fig. 11 is a sectional view of the board-to-board connector 3 in a state that the plug connector 1 and the receptacle connector 2 are fitted to each other, showing an engaging state between the plug engaging member 51 and the receptacle engaging member 151; and

[0026] Fig. 12 is a sectional view of a conventional electrical connector.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0027] While the Present Application may be susceptible to embodiment in different forms, there is shown in the Figures, and will be described herein in detail, specific embodiments, with the understanding that the disclosure is to be considered an exemplification of the principles of the Present Application, and is not intended to limit the Present Application to that as illustrated.

[0028] In the illustrated embodiments, directional representations – *i.e.*, up, down, left, right, front, rear and the like, used for explaining the structure and movement of the various elements of the Present Application, are relative. These representations are appropriate when the elements

are in the position shown in the Figures. If the description of the position of the elements changes, however, it is assumed that these representations are to be changed accordingly.

[0029] An embodiment of the Present Application will be explained in detail below with reference to the drawings. At first, the plug connector 1 will be explained with reference to Fig.

2. The plug connector 1 is a member which has a rectangular prism-shaped or rectangular parallelepiped contour. The plug connector 1 is mounted on a board 91 by soldering plug contacts or contact terminals (plug connector terminals) 61 to the board 91 as described later on. In this specification, the side of the plug connector 1, on which the plug connector 1 is mounted on the board, is appropriately referred to as “mounting side” or “lower side”; and the side, on which the receptacle connector 2 is coupled or fitted to the plug connector 1, is appropriately referred to as “fitting side” or “upper side.” In this specification, a direction (direction indicated as “Y” in Fig. 2), in which the rectangular parallelepiped plug connector 1 extends, is appropriately referred to as “longitudinal direction”; a direction (direction indicated as “X” in Fig. 2), which is perpendicular to the “longitudinal direction” in a plane parallel to the board 91, is appropriately referred to as “transverse direction”; and a direction (direction indicated as “Z” in Fig. 2), which is perpendicular to the plane of the board 91, is appropriately referred to as “height direction.”

[0030] The plug connector 1 mainly has a tub-shaped housing 11, a plurality of plug contacts 61 which are attached or installed to the housing 11, and a pair of plug engaging members 51 which are attached or installed to the housing 11 from the upper side. The housing 11 has a pair of girders or beams or columns 12a, 12b each of which has a predetermined thickness in the height direction and which extend in parallel to each other in the longitudinal direction; a pair of bridges 26a, 26b which extend in the transverse direction to join or couple the both ends of the beams 12a, 12b to one another; and a bottom plate 17. The bottom plate 17 extends on the lower side of the housing 11 so that the beam 12a and the beam 12b are connected to each other and the bridge 26a and the bridge 26b are connected to each other. A space 13 is defined or comparted at the central portion of the housing 11 by the beams 12a, 12b, the bridges 26a, 26b, and the bottom plate 17. A part or portion of the receptacle connector 2 is inserted into the space 13 as described later on.

[0031] The plug engaging members 51 are attached to the bridges 26a, 26b of the plug connector 1. A recess 23a is formed on an upper surface 26Ua of the bridge 26a, and side surface grooves

24a are formed on a pair of side surfaces 26Sa of the bridge 26a so that each of the side surface grooves 24a extends in the height direction. Further, an end surface groove 25a is formed on an end surface 26Ea of the bridge 26a. The recess 23a, the pair of side surface grooves 24a, and the end surface groove 25a form one communicated space; and the plug engaging member 51 is
5 accommodated in this space. Similarly, a recess 23b is formed on an upper surface 26Ub of the bridge 26b, and side surface grooves 24b are formed on a pair of side surfaces 26Sb of the bridge 26b, so that the side surface grooves 24b extend in the height direction respectively. An end surface groove 25b is formed on an end surface 26Eb of the bridge 26b. The recess 23b, the pair of side surface grooves 24b, and the end surface groove 25b form one communicated space; and
10 the plug engaging member 51 is also accommodated in this space.

[0032] The plug engaging member 51 will be explained with reference to Figs. 2 and 3. The plug engaging member 51 is a member which is formed by stamping and bending a conductive metal plate. In this embodiment, the plug engaging member 51 is explained by using the conductive metal. However, it is also allowable to use any material. The plug engaging member
15 51 includes a plate-shaped body 52 which extends in one direction (transverse direction as shown in Fig. 2), and legs 55 which extend in the downward direction (height direction as shown in Fig. 2) respectively from mutually opposing end surfaces of the body 52. Each one of ends of the legs 55 is soldered to the board 91 when the plug connector 1 is attached to the board 91.

Projections and recesses (convex and concave portions), which function as disengagement locks
20 of the plug engaging member 51 with respect to the plug connector 1 of the housing 11, are formed in the vicinity of the ends of the legs 55. Further, an arm 53, which extends in the longitudinal direction, is provided on the body 52 on a same plane parallel to the surface of the body 52. Further, an engaging tab 54, which is rectangular flat plate-shaped, is provided on one of the mutually opposing side surfaces of the arm 53. The engaging tab 54 extends while being
25 bent from the arm 53 in the downward direction perpendicular to the surface of the arm 53.

Further, the engaging tab 54 extends in the extending direction of the arm 53 (in the longitudinal direction as shown in Fig. 2) so that the engaging tab 54 protrudes from the end surface of the arm 53. The portion, which protrudes from the end surface of the arm 53, is an engaging portion 54a. The bending direction of the engaging tab 54 is same as the bending direction of the leg 55
30 with respect to the surface of the arm 53 (surface of the body 52). The cross section, of the engaging tab 54 (engaging portion 54a), in the longitudinal direction in Fig. 2 is substantially

rectangular. As described later on, when the receptacle connector 2 and the plug connector 1 are fitted to each other, the engaging portion 54a is engaged with a cutout 154 provided on the receptacle engaging member 151. The engaging tab 54 is positioned at the substantially central portion in the transverse direction in Fig. 2.

5 [0033] An explanation will be made with reference to Figs. 2 and 8 about the attachment (installation) of the plug engaging members 51 to the plug connector 1. The plug engaging members 51 are fitted into the recesses 23a, 23b, the side surface grooves 24a, 24b, and the end surface grooves 25a, 25b of the bridges 26a, 26b respectively, and the plug engaging members 51 are pressed from above. As a result, the plug engaging members 51 are attached to the plug
10 connector 1. The legs 55 of the plug engaging members arrive at the board 91 at the inside of the side surface grooves 24a, 24b. By soldering the legs 55 to the board 91, the legs 55 are mechanically connected to the board 91. As a result, the plug engaging members 51 reinforce the connection between the plug connector 1 and the board 91. Further, the engaging tabs 54 are inserted into the end surface grooves 25a, 25b. As shown in Fig. 8, a part or portion of each of
15 the engaging tabs 54 protrudes to the outside of the housing 11 from one of the bridge end surfaces 26Ea, 26Eb.

[0034] Next, the receptacle connector 2 will be explained with reference to Figs. 4 and 5. The receptacle connector 2 is a member which has a rectangular prism-shaped or rectangular parallelepiped contour. The receptacle connector 2 is mounted on the board 191 by soldering
20 receptacle contacts or contact terminals 161 to the board 191 as described later on. In this specification, the side of the receptacle connector 2, on which the receptacle connector 2 is mounted on the board, is appropriately referred to as “mounting side” or “lower side”; and the side, on which the plug connector 1 is coupled or fitted to the receptacle connector 2, is appropriately referred to as “fitting side” or “upper side.” In this specification, a direction
25 (direction indicated as “Y” in Fig. 4), in which the rectangular parallelepiped receptacle connector 2 extends, is appropriately referred to as “longitudinal direction”; a direction (direction indicated as “X” in Fig. 4), which is perpendicular to the “longitudinal direction” in a plane parallel to the board 191, is appropriately referred to as “transverse direction”; and a direction
30 (direction indicated as “Z” in Fig. 4), which is perpendicular to the plane of the board 191, is appropriately referred to as “height direction.”

[0035] The receptacle connector 2 has a tub-shaped housing 101, a plurality of receptacle contacts 161 which are attached or installed to the housing 101, and a pair of receptacle engaging members 151 which are attached or installed to the housing 101 from the lower side. The housing 101 has a pair of girders or beams or column 112a, 112b each of which has a predetermined thickness in the height direction and which extend in parallel to each other in the longitudinal direction; a pair of bridges 126a, 126b which extend in the transverse direction to join or couple the both ends of the beams 112a, 112b to one another; and a bottom plate 117. The bottom plate 117 extends on the lower side of the housing 101 so that the beam 112a and the beam 112b are connected to each other and the bridge 126a and the bridge 126b are connected to each other. A ridge portion 114 protrudes from the central portion of the bottom plate 117, and the ridge portion 114 extends in the longitudinal direction.

[0036] A space 113 is defined or comparted at the central portion of the housing 101 by the beams 112a, 112b, the bridges 126a, 126b, and the bottom plate 117; and the ridge portion 114 is positioned in the space 113. The part or portion of the plug connector 1 described above is inserted into the space 113.

[0037] Grooves 123a, 123b, into each of which a part or portion of one of the receptacle engaging members 151 is inserted, are formed respectively on the lower surfaces 126Ba, 126Bb of the bridges 126a, 126b of the receptacle connector 2.

[0038] The receptacle engaging member 151 will be explained with reference to Figs. 4 and 6.

The receptacle engaging member 151 is a member which is formed by stamping and bending a conductive metal plate. The receptacle engaging member 151 includes a plate-shaped body 152 which extends in one direction (transverse direction as shown in Fig. 4), and a pair of side walls 153 which extend from the both ends of the plate-shaped body 152 in a same direction while being bent substantially perpendicularly. In this embodiment, the receptacle engaging member 151 is explained by using the conductive metal. However, it is also allowable to use any material. The receptacle engaging member 151 has a shape of “staple” (shape of horizontally placed bracket) formed by the body 152 and the pair of side walls 153. Projections and recesses (convex and concave portions), which function as disengagement locks of the receptacle connector 2 with respect to the housing 101, are formed on an end surface 153a of each of the side walls 153. Central portions of the body 152 protrude in the height direction (upward direction) as shown in Fig. 4 to form protrusions 156. Further, the cutout 154 is formed, which is

continued from the protrusions 156 to the body 152. The cutout 154 is positioned at the substantially central portion of the body 152, and the cutout 154 extends from one side (side on which the protrusions 156 are formed) to the other side of the body 152. A fastening portion 154a, which serves as a terminal (bottom), is defined at a position close to the other side of the body 152. A part or portion of the body 152 is divided, at the protrusions 156, by the cutout 154 into two portions which are opposite to or face each other, and a pair of wall surfaces 152a which extend in parallel to each other are defined. When the receptacle connector 1 and the plug connector 2 are fitted to each other as described later on, the engaging tab 54 of the plug engaging member 51 is engaged with the cutout 154. When the plug connector 1 is fitted to the receptacle connector 2, the cutout 154 functions as a guide. In other words, when the engaging tab 54 is engaged with the cutout 154, the wall surfaces 152a function as guides. Further, parts or portions of the pair of side walls 153 protrude in a direction opposite to the protruding direction of the protrusions 156, i.e., in the downward direction so as to provide soldering tabs 155. The soldering tabs 155 are bent approximately perpendicularly to extend toward the outer side of the receptacle engaging member 151. As described later on, the soldering tabs 155 are soldered to the board 191.

[0039] An explanation will be made with reference to Figs. 4 and 5 about the attachment or installation of the receptacle engaging members 151 to the receptacle connector 2. The sides, of the receptacle engaging members 151, on which the protrusions 156 are formed, are made to be opposite to or face the grooves 123a, 123b formed on the lower surfaces 126Ba, 126Bb of the brides 126 of the receptacle connector 2; and the receptacle engaging members 151 are fitted into the grooves 123a, 123b, and are pressed from below. As a result, the receptacle engaging members 151 are attached to the receptacle connector 2. The central portions of the bodies 152, at which the cutouts 154 are formed, are exposed in the space 113 of the receptacle connector 151. Further, the pairs of the soldering tabs 155 are soldered to the board 191, and thus the soldering tabs 155 are mechanically connected to the board 191. With this, the receptacle engaging members 151 reinforce the connection between the receptacle connector 2 and the board 191.

[0040] Each of the housing 11 in the plug connector 1 and the housing 101 in the receptacle connector 2 of this embodiment explained above can be formed as an integrated part (component) with an insulative material including, for example, synthetic resin. Examples of the

sizes of the plug connector 1 and the receptacle connector 2 manufactured in this embodiment are shown below. The housing 11 has sizes of longitudinal dimension (X direction): about 1.8 mm, lateral dimension (Y direction): about 5.7 mm, and thickness (Z direction): about 0.6 mm. The space 13 has a size of width (X direction): about 0.9 mm. The housing 101 has sizes of longitudinal dimension (X direction): about 3.0 mm, lateral dimension (Y direction): about 7.3 mm, and thickness (Z direction): about 0.7 mm. The ridge portion 114 has a size of width (X direction): about 0.8 mm. The plurality of plug contacts 61 provided on the plug connector 1 are formed as 10 pieces of the plug connectors 61 and are formed on each of the beams 12a, 12b at pitches of about 0.4 mm. The same number of the receptacle contacts 161, which are formed for the receptacle connector 2, are provided on each of the beams 112a, 112b at the same pitches as those of the plug connector 1 corresponding thereto.

[0041] An explanation will be made about the fitting or mating between the plug connector 1 and the receptacle connector 2 and the engagement between the plug engaging members 51 and the receptacle engaging members 151. At first, a mating surface of the plug connector 1 (upper side in Fig. 2) and a mating surface of the receptacle connector 2 (upper side in Fig. 4) are made to be opposite to or face each other. In this situation, as shown in Figs. 7 and 8, the engaging portions 54a of the plug engaging members 51 are made to be opposite to or face the cutouts 154 of the receptacle engaging members 151. Subsequently, the connected projection shape, which is formed of the beams 12a, 12b and the bridges 26a, 26b of the plug connector 1, is fitted or mated into the recessed shape which is formed of the space 113 of the receptacle connector 2, to thereby fit or mate the plug connector 1 and the receptacle connector 2 to each other. The plurality of plug contacts 61 provided on the plug connector 1 and the plurality of receptacle contacts 161 provided on the receptacle connector 2 are elastically brought in contact with one another respectively, and are electrically connected to one another. In this situation, as shown in Fig. 9 and Figs. 10A and 10B, the engaging portions 54a are inserted or mated into the cutouts 154 to effect the sliding engagement, thereby engaging the plug engaging members 51 and the receptacle engaging members 151 with each other while being positionally adjusted. The engaging portion 54a and the cutout 154, which are engaged with each other, have the sizes which have a predetermined relationship as described later on.

[0042] Anti-inclined unmating mechanism of the electrical connector 3 will be explained with reference to Fig. 11. An operation is assumed, in which a user intends to detach the board 91

from the board 191 by inclining the board 91. When the board 91 is inclined with respect to the board 191, and the force is applied in a direction separating the board 91 from the board 191, then the force in the inclined direction is also applied to the plug connector 1 attached to the board 91. In this situation, the engaging tab 54 of the plug engaging member 51 attempts to rotate (incline) in the direction of the force. However, the rotation is suppressed by the cutout 154 of the receptacle engaging member 151 with which the engaging tab 54 is engaged. That is, in this embodiment, the engaging tab 54 is formed to have a sufficient size as compared with the size of the cutout 154 so that the rotation of the engaging tab 54 is suppressed in the cutout 154. Therefore, when the engaging tab 54 is rotated (inclined) or when the engaging tab 54 attempts to rotate (incline), then the corner of the substantially rectangular cross section of the engaging tab 54 abuts against the wall surface 152a which defines the cutout 154, and any further rotation is prevented or prohibited. As a result, the plug connector 2, to which the plug engaging member 51 is attached, is suppressed from rotating, thereby preventing the electrical connector 3 from the inclined unmating.

[0043] In a state that the anti-inclined unmating mechanism is allowed to act or operate as described above, the rotation of the engaging tab 54 is not caused at all, or even when any rotation of the engaging tab 54 is caused, the range of the rotation is within such a range or extent that the electrical connection can be maintained between the plug connector 1 and the receptacle connector 2. In other words, the mating between the plug contact 61 and the receptacle contact 161 is retained within the range in which the engaging tab 54 is rotatable.

[0044] In the electrical connector 3 of this embodiment, the mating between the connectors can be released by the parallel unmating which does not involve any rotation of the connector. When the board 91 and the board 191 are separated from each other while maintaining the boards 91 and 191 in parallel and the plug connector 1 and the receptacle connector 2 are released from the fitting or mating, then the engaging tabs 54 abut against the wall surfaces 152a, and the engaging tabs 54 are guided along the cutouts 154 while making the sliding so that the engaging tabs 54 are moved to the outside from the cutouts 154, thus releasing the engagement between the engaging tabs 54 and the cutouts 154. In this embodiment, it is possible to effectively avoid the inclined unmating of the electrical connector, while providing such a structure that allows the releasing operation (parallel unmating) to be easily performed for the mating between the connectors. According to the Present Application, the connectors are released from the mating

by the parallel unmating. A situation can be assumed such that the engaging tab 54 might be unmated from the cutout 154 in a state that the engaging tab 54 is finely or slightly rotated. However, since the friction is generated by the sliding movement between the engaging tab 54 and the wall surface 152a of the cutout 154, the unmating hardly occurs and the inclined unmating is suppressed.

[0045] In view of the effective prevention of the inclined unmating, it is desirable that the sizes of the respective portions of the plug engaging member 51 and the receptacle engaging member 151 have the following relationship. Namely, in the state that the engaging tab 54 is engaged with the cutout 154, it is preferable that the length (“a” shown in Fig. 10B) of the engaging tab 54, in the depth direction of the cutout 154, is longer than the width (“d” shown in Fig. 10B) of the cutout 154. With this, it is possible to assuredly prevent or prohibit the rotation of the engaging tab 54 in the cutout 154. In the engaging tab 54 of this embodiment, the depth direction of the cutout 154 is the same direction as the perpendicular direction with respect to the surface of the body 52 of the plug engaging member.

[0046] Further, in the state that the engaging tab 54 is engaged with the cutout 154, it is preferable that the depth (“e” shown in Fig. 10B) of the cutout 154 is longer than the length (“a” shown in Fig. 10B) of the engaging tab 54 in the depth direction of the cutout 154. With this, it is possible to make the engaging tab 54 be assuredly engaged with the cutout 154, and it is possible to avoid the release from the engagement.

[0047] Examples of the sizes of the plug engaging member 51 and the receptacle engaging member 151 manufactured in this embodiment are shown below. In the plug engaging member 51, the length (“a” shown in Fig. 10B) of the engaging tab 54 in the perpendicular direction with respect to the surface of the body 52 was 0.22 mm, the thickness (“b” shown in Fig. 10A) of the engaging tab 54 was 0.08 mm, and the length (“c” shown in Fig. 10A) in the protruding direction of the portion (engaging portion 54a) protruding from the arm 55 of the engaging tab 54 was 0.25 mm. In the receptacle engaging member 151, the width (“d” shown in Fig. 10B) of the cutout 154 was 0.1 mm, and the depth (“e” shown in Fig. 10B) of the cutout 154 was 0.4 mm. Further, in the state that the engaging tab 54 was engaged with the cutout 154, the distance (“f” shown in Fig. 10B) from the end portion of the engaging tab 54 to the end portion of the protrusion 156 was 0.12 mm, and the length (“g” shown in Fig. 10A) in the protruding direction of the engaging tab 154 protruding from the surface of the body 152 of the receptacle engaging

member 151 was 0.05 mm. In this embodiment, the length “a” (0.22 mm) of the engaging tab 54 in the depth direction of the cutout 154 is greater than the width “d” (0.1 mm) of the cutout 154, and the depth “e” (0.4 mm) of the cutout 154 is greater than the length “a” (0.22 mm) of the engaging tab 54 in the depth direction of the cutout 154. Therefore, it is possible to efficiently avoid the inclined unmating of the electrical connector.

[0048] The engaging tab 54 and the cutout 154 can be provided at the substantially central portions in the extending direction (transverse direction in Figs. 2 and 4) of the respective bodies 52, 152 in the plug engaging member 51 and the receptacle engaging member 151. By providing the engaging tab 54 and the cutout 154 at the substantially central portions in the extending direction (transverse direction in Figs. 2 and 4) of the bodies 52, 152, it is possible to exhibit an equivalent effect for the inclined unmating exerted from any one of the left and the right of the electrical connector as well.

[0049] The boards 91, 191 of this embodiment are, for example, printed circuit boards to be used, for example, for the electronic device. However, it is also allowable to use the board of any type including, for example, FPC. In particular, in a case that FPC is used, the Present Application is effective since there is a high possibility that any unintentional inclined unmating might be caused with respect to the FPC.

[0050] Since the plug engaging member 51 and the receptacle engaging member 151 of this embodiment are soldered to the boards respectively, the plug engaging member 51 and the receptacle engaging member 151 each have the function to strongly fix the connectors to the boards. The engaging members 51, 151 simultaneously have the function to avoid the inclined unmating and the function to strengthen the force for fixing the connectors to the boards, to thereby making it possible to decrease the number of parts or components of the connectors. In view of preventing the inclined unmating of the electrical connector, it is not necessarily indispensable that the plug engaging member 51 and the receptacle engaging member 151 have the function to reinforce the fixing of the connectors to the boards.

[0051] In this embodiment, the plug engaging member 51 has the engaging tab 54, and the cutout 154 is formed in the receptacle engaging member 151. On the contrary, it is allowable that the receptacle engaging member 151 has an engaging tab, and that a cutout is formed in the plug engaging member 51.

[0052] In this embodiment, one piece of the engaging structure constructed of the engaging tab 54 and the cutout 154 is provided for the electrical connector 3. However, a plurality of pieces of the engaging structure may be provided for the electrical connector 3. In this case, at least one of the plurality of engaging structures is arranged at the substantially central portion in the extending direction of the body 52, 152 (transverse direction as shown in Figs. 2 and 4).

Alternatively, a plurality of engaging structures are arranged symmetrically to interpose the substantially central portion in the extending direction of the body 52, 152 (transverse direction as shown in Figs. 2 and 4).

[0053] In this embodiment, the cutout is formed, which has the constant width ("d" shown in Fig. 10B) of the cutout 154. However, it is not necessarily indispensable that the width of the cutout is constant, provided that the rotation of the engaging tab 54 can be suppressed by the cutout 154. For example, the following case is assumed. That is, even when the groove width provided in the vicinity of the fastening portion 154a of the cutout is greatly expanded to such an extent that the rotation of the engaging tab 54 cannot be suppressed, the groove width is narrow at any other portion of the cutout (portion located closely to the side at which the protrusion 156 is formed), and the rotation of the engaging tab 54 can be suppressed by the portion having the narrow groove width.

[0054] The electrical connector, which is exemplified by the board-to-board connector of the Present Application, is the connector electrically connecting the board to the board, and having such a structure that the inclined unmating is hardly caused. Therefore, even when any unexpected force is applied in the inclined direction, it is possible to avoid the release of the mating or fitting of the connectors. Therefore, the board-to-board connector of the Present Application can be effectively utilized, for example, as the connector for connecting the boards or the like, for example, in the small-sized electronic device.

[0055] While a preferred embodiment of the Present Application is shown and described, it is envisioned that those skilled in the art may devise various modifications without departing from the spirit and scope of the foregoing Description and the appended Claims.

CLAIMS**WHAT IS CLAIMED IS:**

- 5 1. An electrical connector comprising;
 a first connector having a first engaging member with a protrusion; and
 a second connector having a second engaging member formed with a cutout;
 wherein the protrusion is engaged with the cutout so that the first connector and
the second connector are electrically connected to each other; and the cutout is configured to
10 suppress the protrusion from rotating in the cutout.
2. The electrical connector of Claim 1, wherein the protrusion is so suppressed from
rotating that an electrical connection between the first and second connectors is maintained.
- 15 3. The electrical connector of Claim 1, wherein the protrusion is not allowed to
rotate in the cutout.
4. The electrical connector of Claim 1, wherein a length of the protrusion in a depth
direction of the cutout is greater than a width of the cutout with which the protrusion is engaged.
20
5. The electrical connector of Claim 1, wherein a depth of the cutout is greater than a
length of the protrusion in a depth direction of the cutout with which the protrusion is engaged.
6. The electrical connector of Claim 1, wherein each of the first and second
25 engaging members has a body which extends in one direction.
7. The electrical connector of Claim 6, wherein the protrusion and the cutout are
formed directly or indirectly at a mid portion in an extending direction of the body.
- 30 8. The electrical connector of Claim 1, wherein the first connector is connected to a
first board, the second connector is connected to a second board.

9. The electrical connector of Claim 8, wherein at least one of the first board and the second board is a flexible printed circuit board.

5 10. The electrical connector of Claim 1, wherein the first connector is connected to a first board, and the second connector is connected to a second board.

11. The electrical connector of Claim 10, wherein the first engaging member is connected to the first board, and the second engaging member is connected to the second board.

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12. The electrical connector of Claim 1, wherein the protrusion is a flat plate which extends in a direction in which the first connector and the second connector are connected to each other.

15 13. The electrical connector of Claim 12, wherein the cutout is a slit which is slidably engageable with the flat plate.

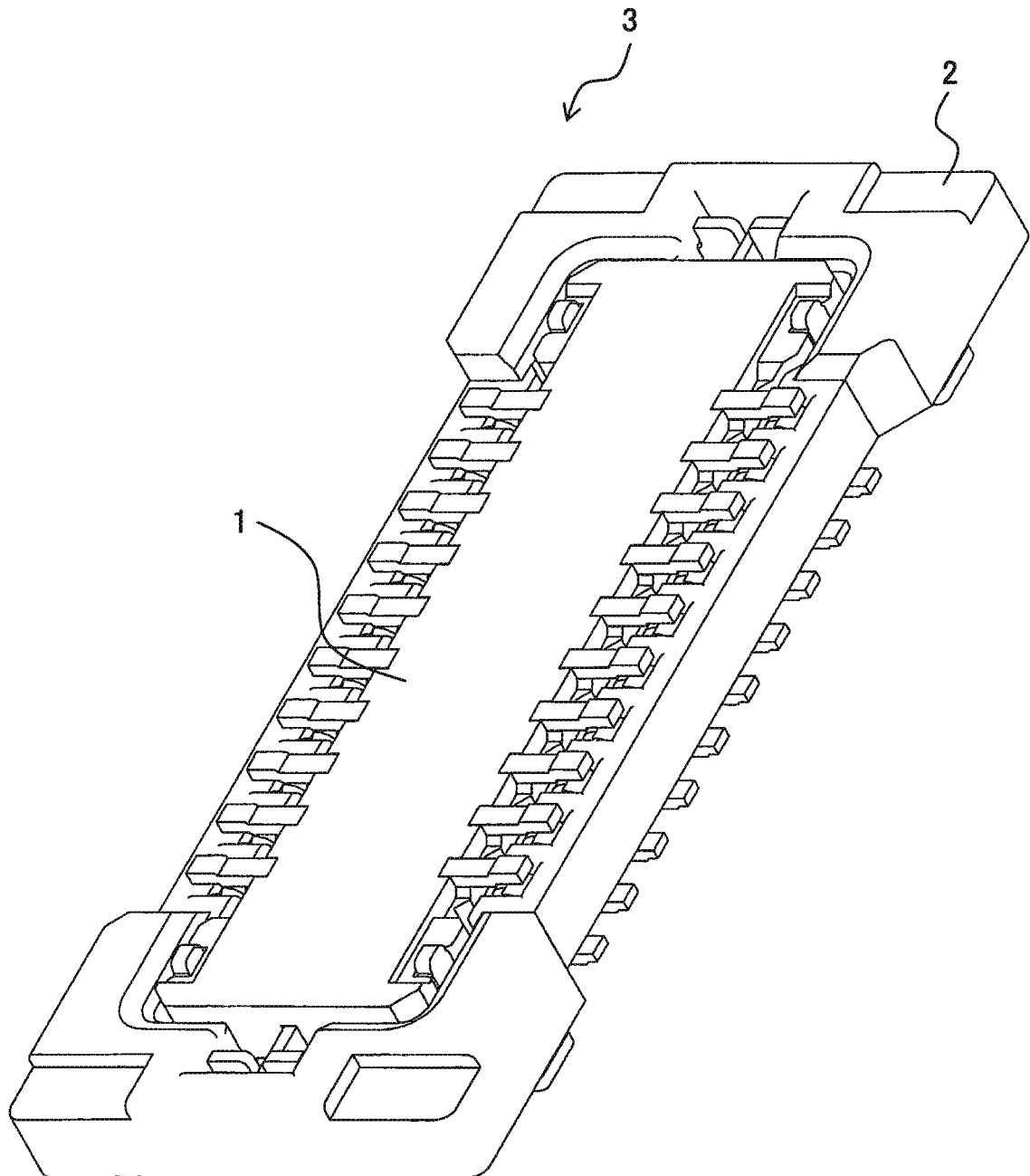
Fig. 1

Fig. 2

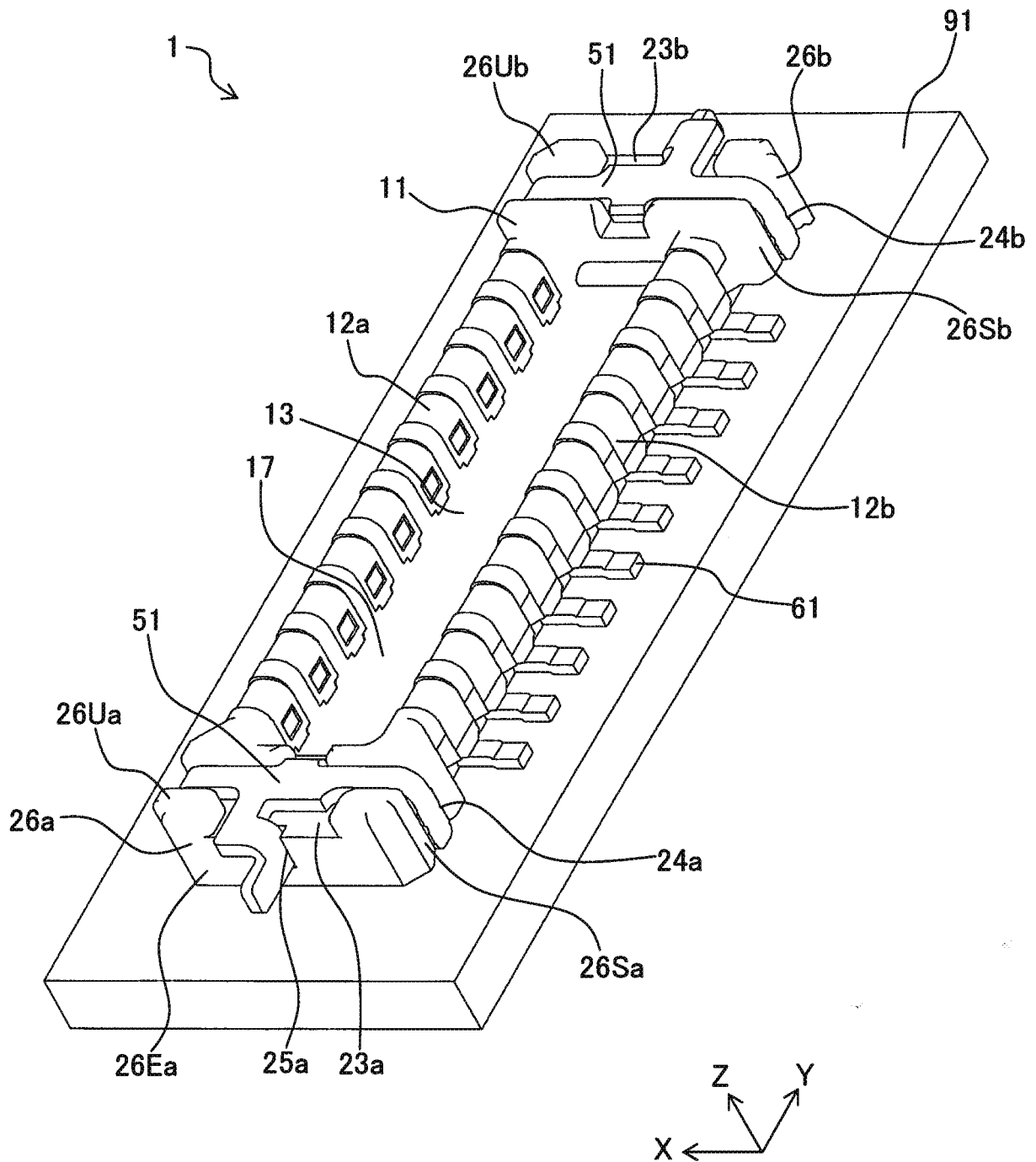


Fig. 3

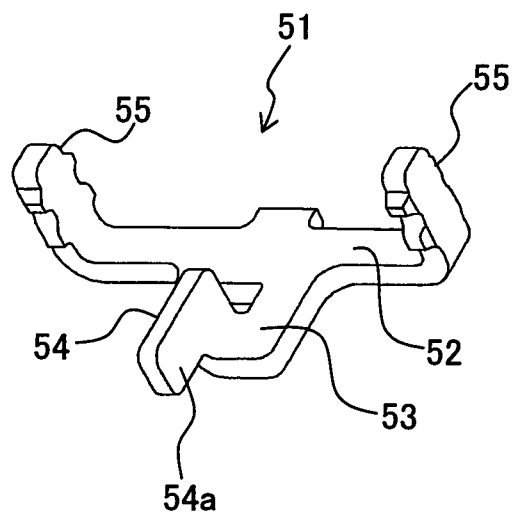


Fig. 4

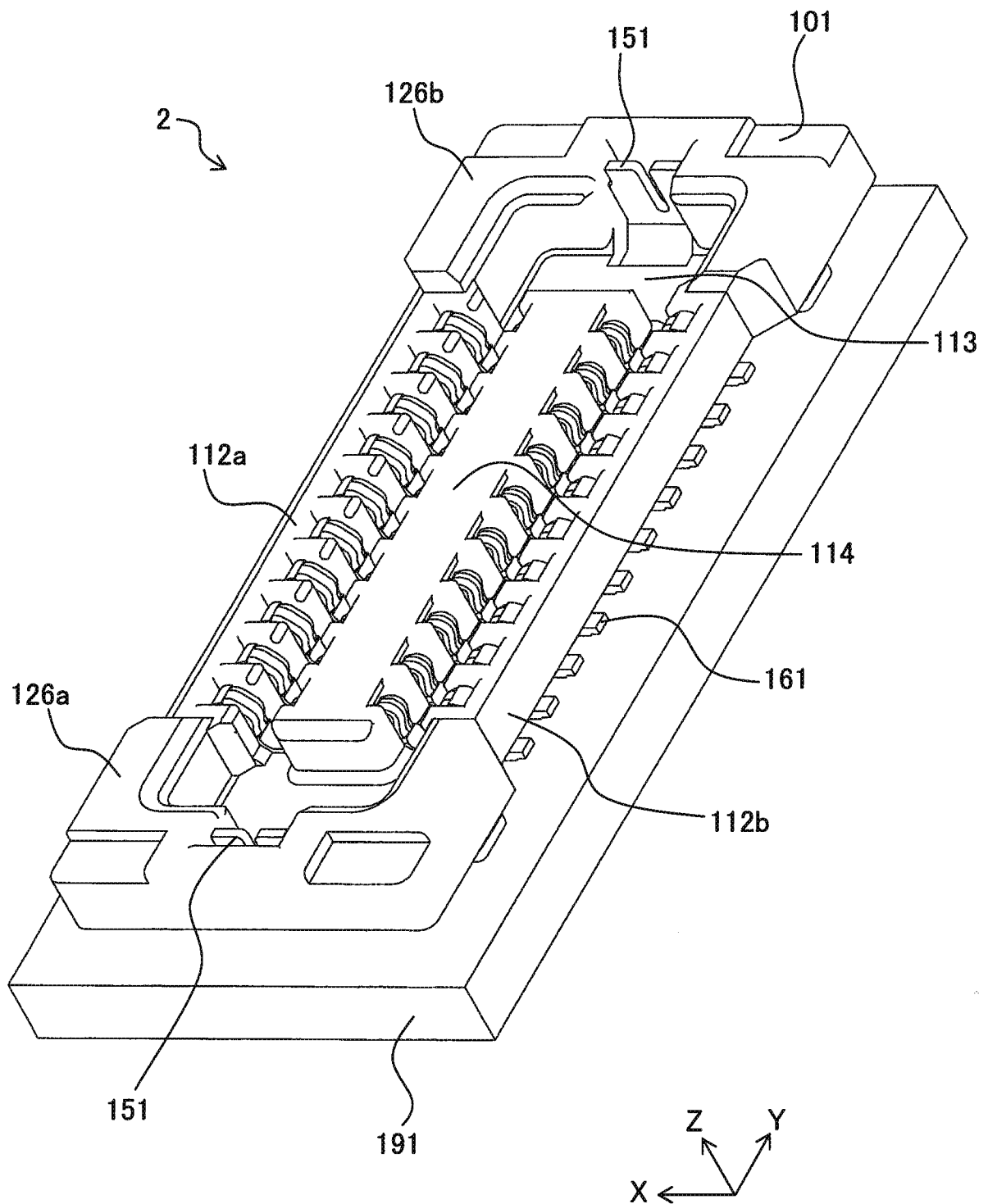


Fig. 5

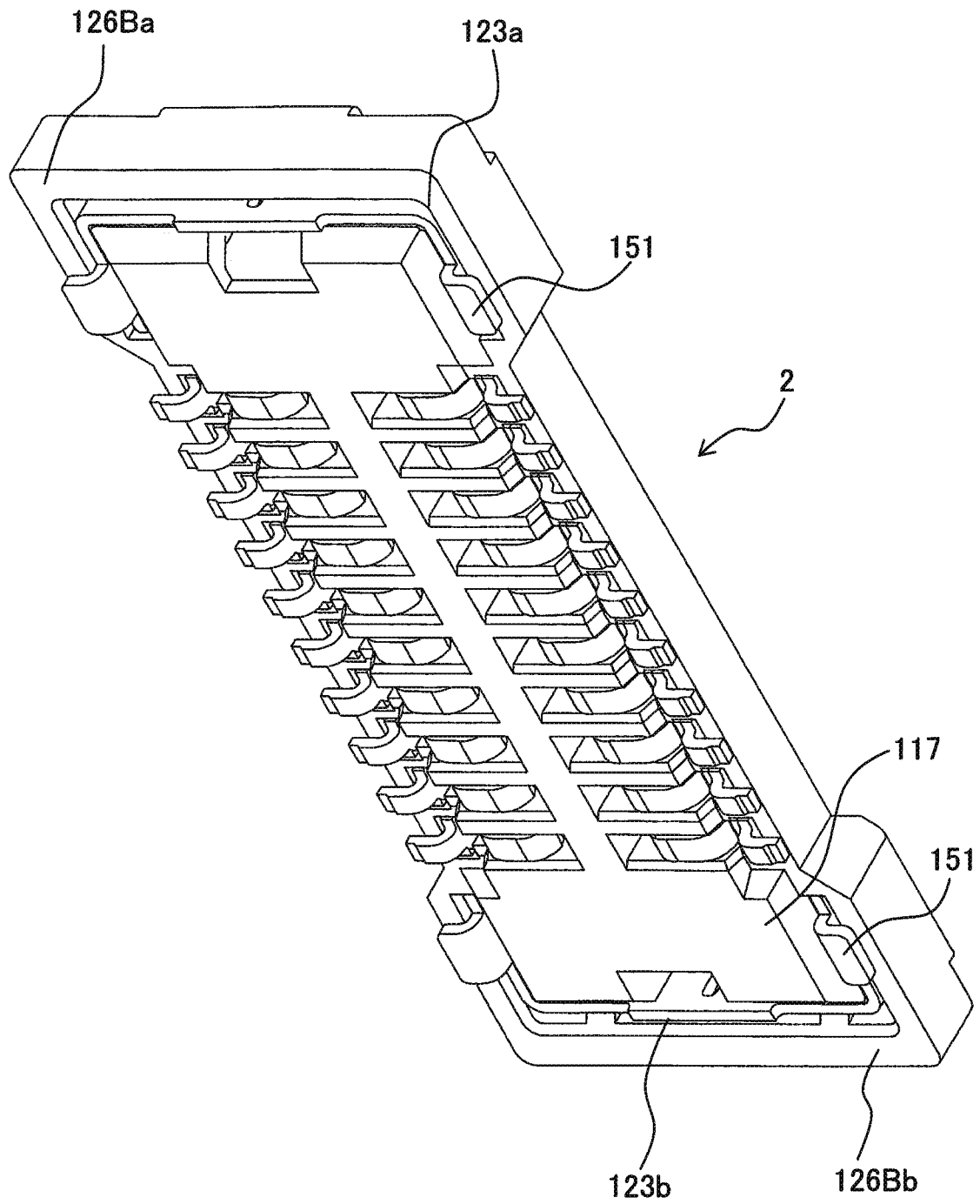


Fig. 6

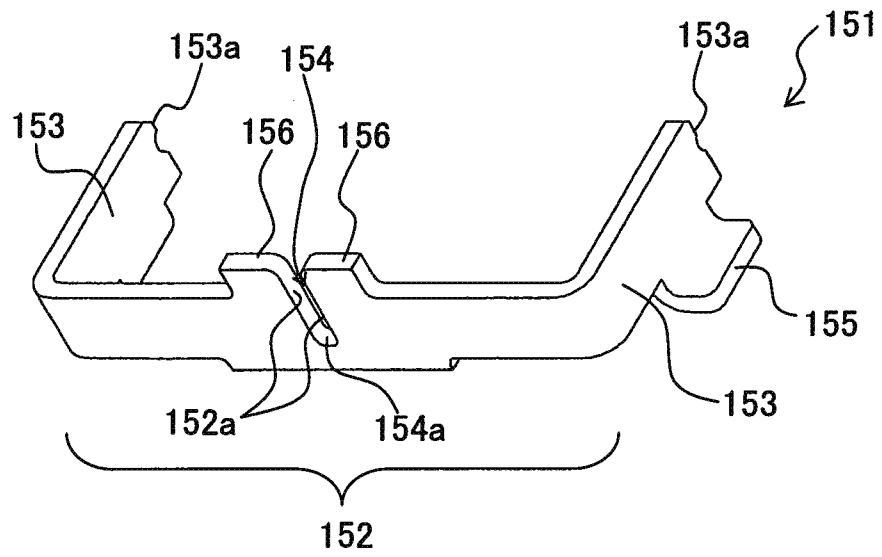


Fig. 7

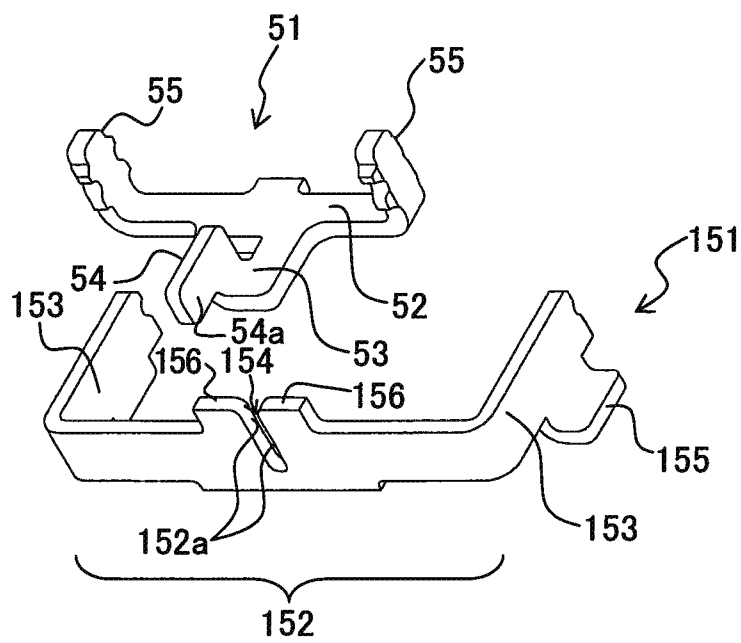
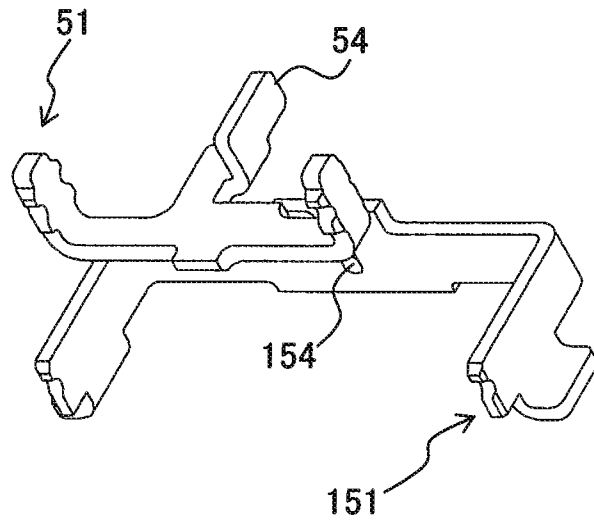


Fig. 8

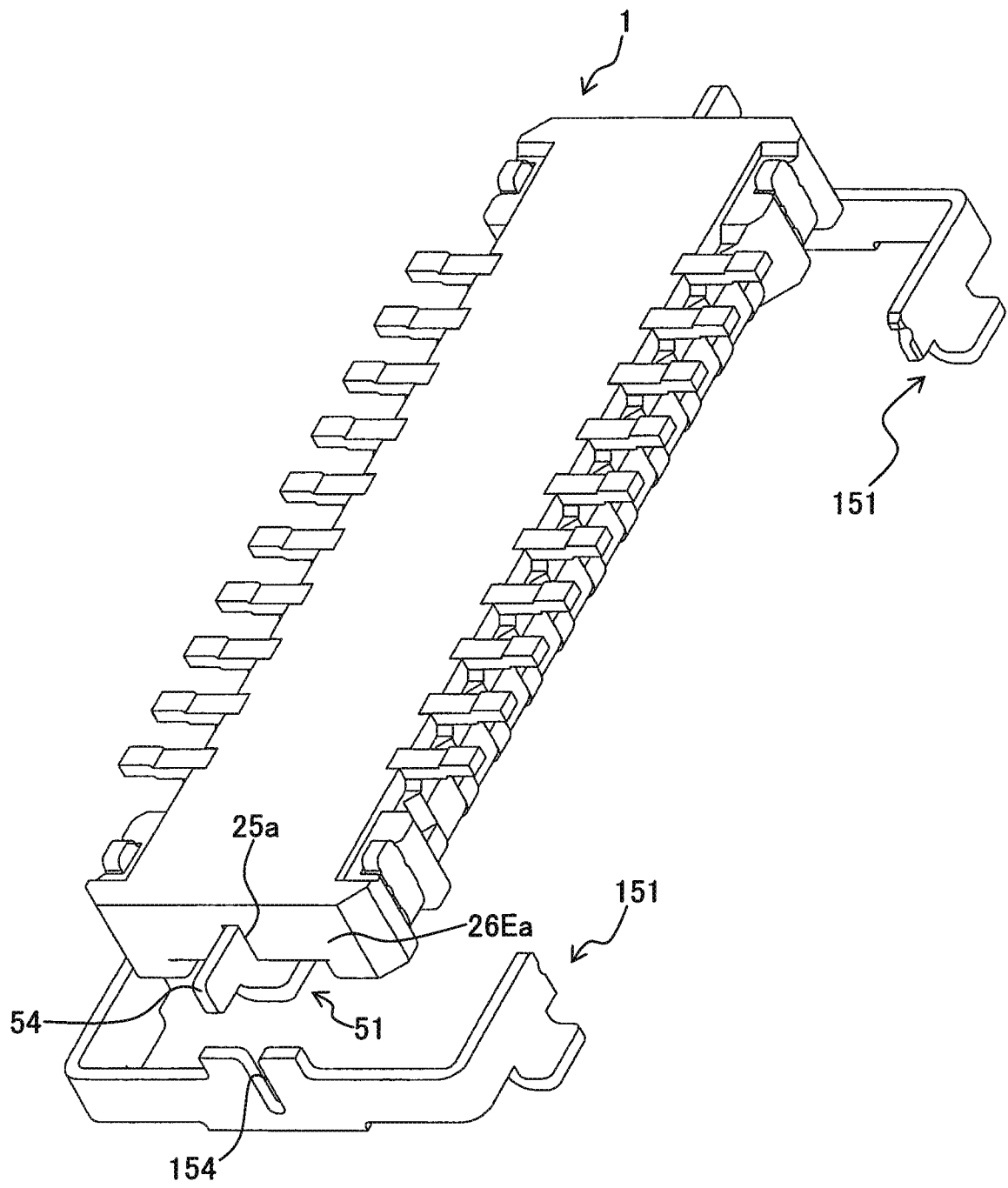


Fig. 9

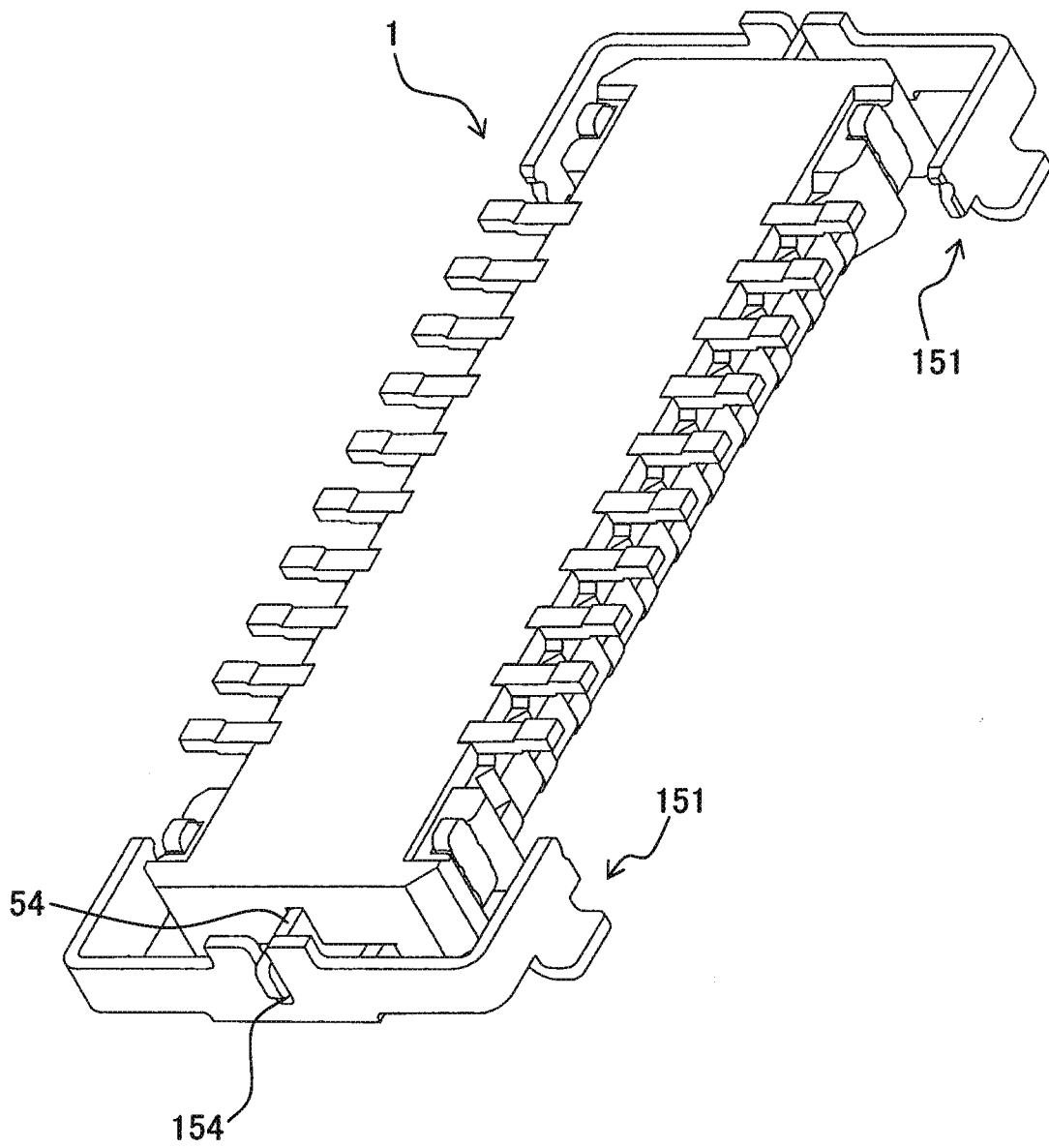


Fig. 10A

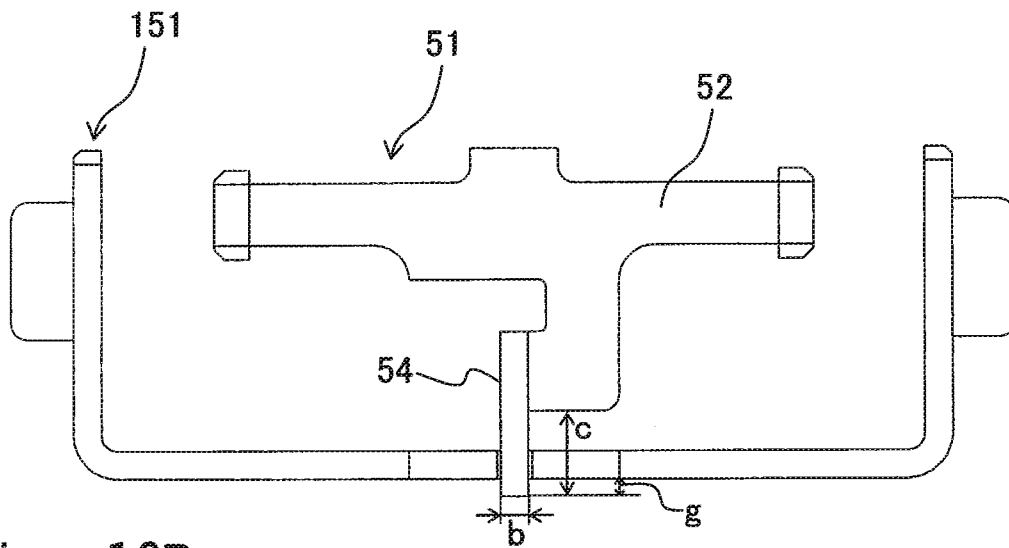


Fig. 10B

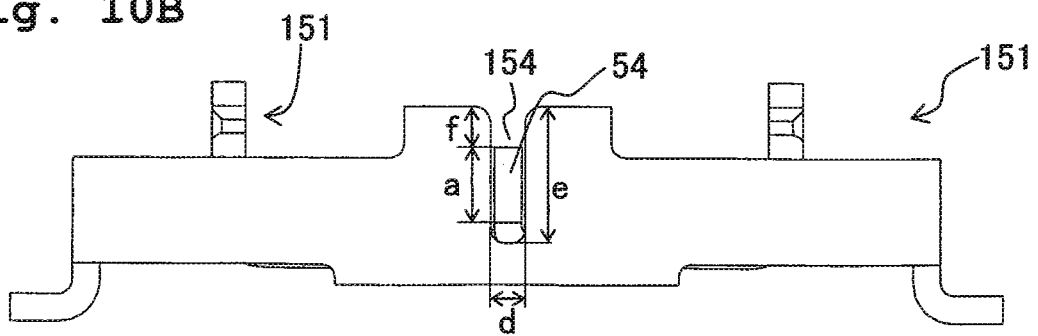


Fig. 11

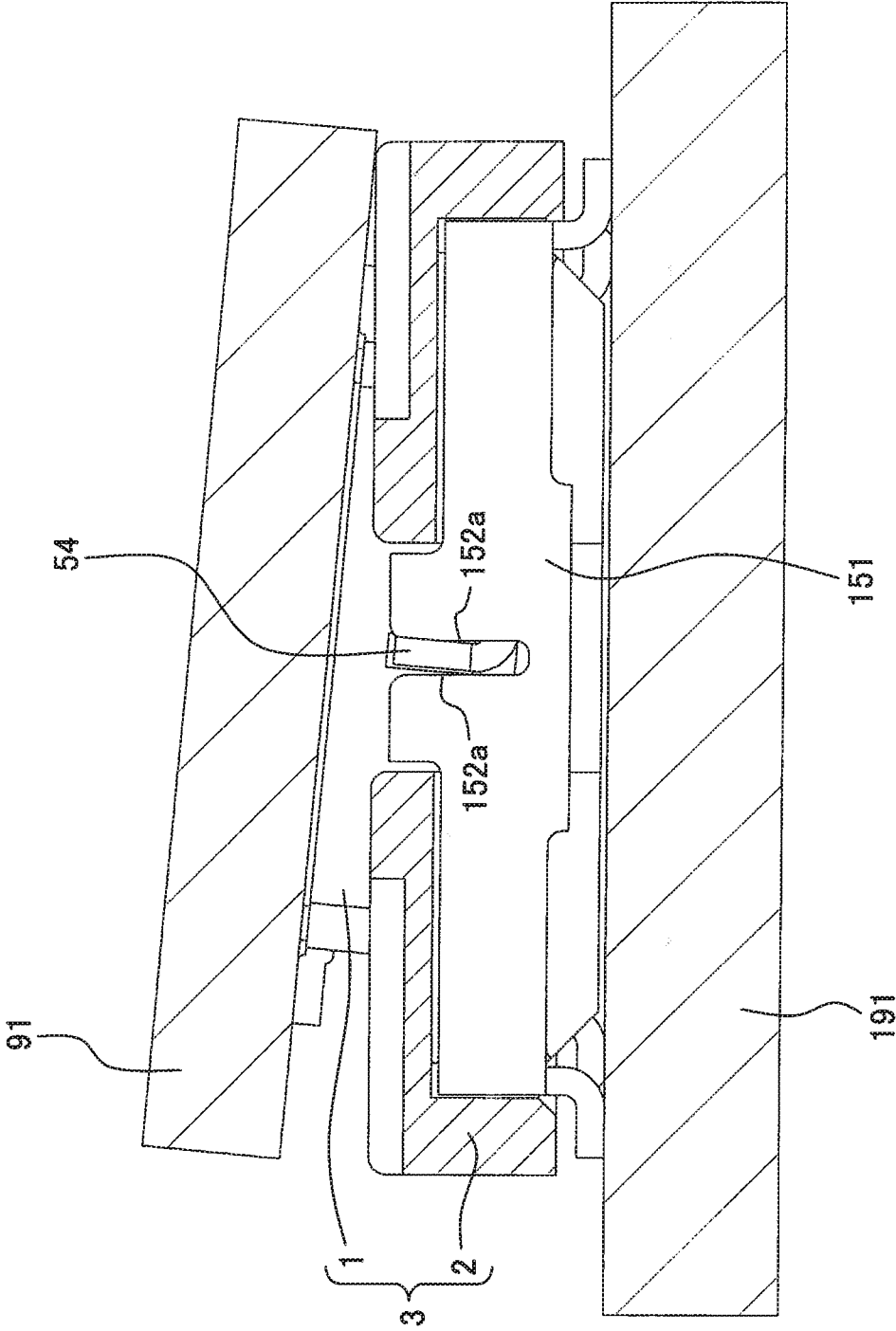


Fig. 12

